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FUEL SUPPLY AND IGNITION SYSTEM

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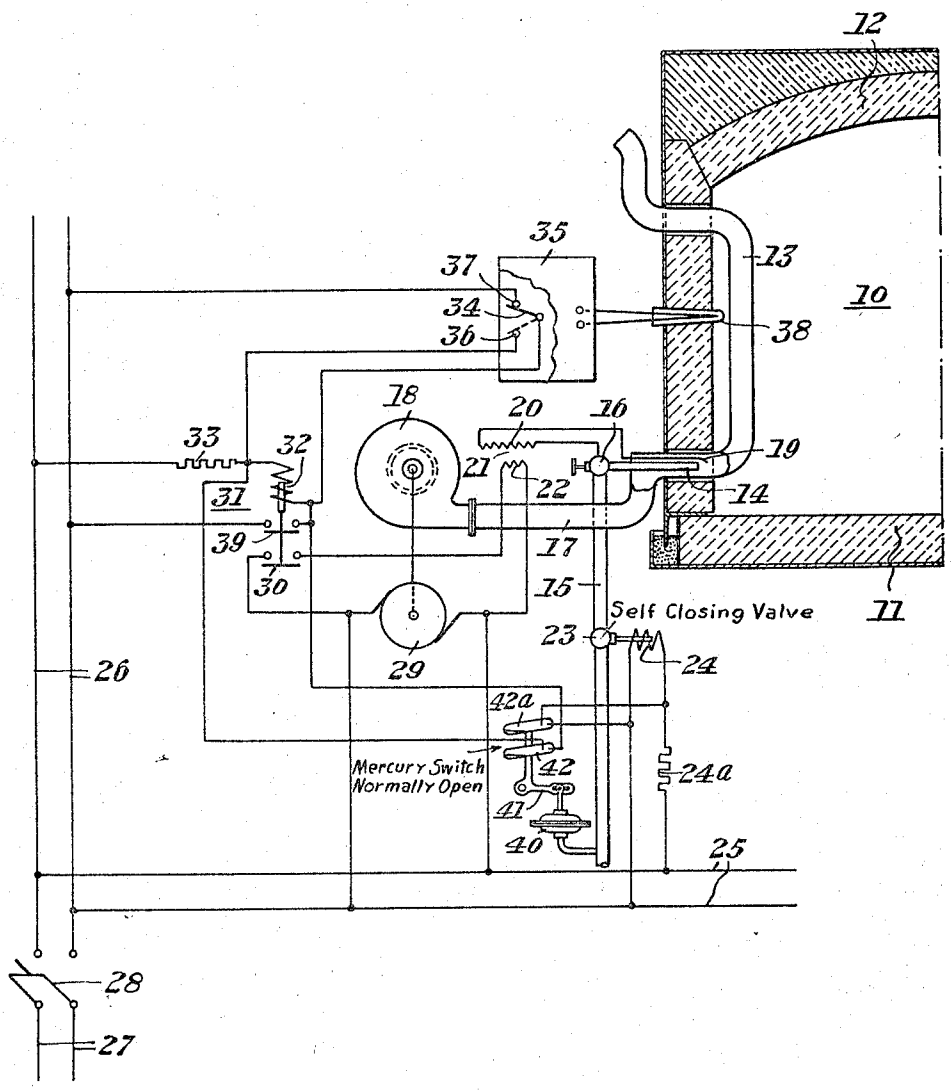

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FUEL SUPPLY AND IGNITION SYSTEM

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1 Claim. (Cl. 158—28)

This invention relates to a system for supplying fuel to consuming devices, controlling the flow thereof, and the ignition of the fuel as it issues from said devices. The invention is designed particularly for the ignition of fluid fuel supplied to burners employed for heating furnaces or the like, but is not limited to such application.

Spark gaps for the ignition of gaseous fuel have been used heretofore with considerable success and it is the object of my invention to provide a unitary control system for the fuel-supply connections delivering such fuel to burners, as well as for the means supplying air for combustion to the burners. It is a further object of my invention to provide means for controlling the spark-gap ignition means in accordance with the temperature in the space being heated so that the ignition means will be de-energized when said temperature is sufficient to insure ignition and combustion of the fuel supplied thereto.

Specifically, my invention is adapted for igniting the fuel supplied to the burners of an annealing furnace of the cover type, such as illustrated in Wilson Patent #1,952,402, which is provided with heat-exchange tubes through which combustion gases flow to heat the interior of the furnace by radiation. In accordance with the invention, I provide a spark gap adjacent each burner for igniting the fuel issuing therefrom. I also provide a safety shutoff valve for terminating the supply of fuel to the burners in case of failure of the current source from which the igniters are energized. A common control means controls the shutoff valve and the igniters, as well as a motor-driven means for supplying air for combustion to the burners. I also provide means responsive to the temperature in the furnace for de-energizing the igniters when the heat-exchange tubes have been heated to a temperature such as to insure the immediate ignition of any additional fuel supplied to the burners thereof.

For a complete understanding of the invention, reference is made to the accompanying drawing illustrating a present preferred embodiment, and to the following detailed description. The single figure of the drawing is a circuit diagram showing the control system and including a diagrammatic illustration of the furnace, its burners, and the means for supplying fuel and air thereto.

Referring in detail to the drawing, a furnace 10 comprises a base 11 and a liftable hood or cover 12 cooperating therewith. The side walls of the cover 12 (which is open at the bottom), are provided with heat exchange tubes 13, each of which has a burner 14 in the lower end thereof. A header 15 connected to any suitable source of fluid fuel, feeds the burners under the control of burner valves 16. Air for combustion is supplied to the lower ends of the tubes 13 from a header 17 connected to the outlet of a blower 18.

Each burner is provided with an igniter point 19 mounted there adjacent but insulated therefrom. The igniter points of several burners are connected in parallel to one terminal of the secondary winding 20 of a transformer 21. The other terminal of the winding is grounded on the header 15. Thus, when the primary winding 22 of the transformer 21 is energized, a spark will jump the gap formed between the point 19 and the end of the burner 14 which is metallic and therefore electrically conducting, whereby to ignite fluid fuel issuing from the burner.

A safety shutoff valve 23 is connected in the header 15 and is adapted to be held open normally by a solenoid 24, or other similar means. The solenoid 24 is connected across a circuit 25 which branches from a control bus 26. The bus 26 is adapted to be connected to a current source 27 of suitable voltage by the closing of a manual switch 28.

The blower 18 is driven by a motor 29 which is connected across the circuit 25 so it will be energized as soon as the switch 28 is closed.

The primary winding 22 of the transformer 21 is connected across the circuit 25 in series with a front contact 30 of a relay 31 having an operating winding 32. The winding 32 is adapted to be connected across the control bus 26 in series with a protective resistor 33, by a moving contact 34 of an automatic temperature regulator 35. Devices of this kind are well-known and no detailed description thereof is necessary. It will suffice to state that the contact 34 engages one or the other of its cooperating contacts 36 and 37, depending on the temperature within the furnace as indicated by a thermocouple 38 extending through the wall thereof. While the regulator 35 is usually employed to control the fuel supplied to the burners, to maintain a desired temperature within the furnace, I specify it as typical of the means which I may employ to effect the purposes of this invention. The regulator 35 is so designed and constructed that its contact 34 will engage the contact 37 when the temperature adjacent the thermocouple 38 is below a predetermined value, say 1300° F. When the temperature in the furnace exceeds 1300° F. the contact 34 starts to move away from the contact 37 toward the contact 36 and finally engages the latter when the furnace temperature is at about 1500° F.

A pressurestat 40 is connected to the fuel-supply line 15 and is adapted, through a suitable operating linkage 41, to cause a normally open mercury switch 42 to close and shunt the solenoid 24, permitting the shut-off valve 23 to close, when the pressure in the line falls below a pre-

determined valve. A similar switch 42*a* serves, in a manner to be described in detail later, to cause discontinuance of the ignition spark.

The operation of the system of my invention may be described as follows, assuming that the switch 28 is open and the furnace 10 cold.

The switch 28 is closed to connect the branch 25 of the control bus, as well as the latter, to the supply circuit 27. The solenoid 24 opens the valve 23, admitting fuel to the burners 14. The motor 29 starts, whereupon the blower 18 supplies air to the tubes 13. The winding 32 of the relay 31 is energized, since the contact 34 of the regulator 35 engages its cooperating contact 37, completing the circuit from the left side of the bus 26 through the resistor 33, the winding 32, the contact 34 and the contact 37 to the other side of the control bus. The relay 31 then closes its front contact 30 to connect the primary winding 22 of the transformers 21 across the circuit 25. The relay 31 also closes a second front contact 39 to complete a holding circuit for the winding 32 thereof, whereby energization thereof is continued independently of the contact 34 until the latter engages its cooperating contact 36.

The energization of the transformer 21 causes a spark to appear adjacent the ends of the burners 14 whereby the fuel issuing therefrom is ignited. Combustion of the fuel and the air supplied by the blower 18 continues, so long as the switch 28 is closed and normal voltage exists across the source 27. The sparks between the points 19 and the burners 14 also continue until terminated in a manner which will now be described.

As the temperature within the furnace 10 rises as a result of the heat radiated from the tubes 13, the regulator 35 operates to move the contact 34 away from the contact 37 and into engagement with the contact 36. The opening of the original energizing circuit of the winding 32 of the relay 31 at the contact 37 has no effect because the holding circuit through the front contact 39 of the relay is in parallel therewith. When the contact 34 engages the contact 36, however, as it does when the furnace temperature has risen to about 1500° F., the winding 32 of the relay 31 is shunted and thus de-energized. The resistor 33 limits the current drawn from the bus 26 when the contact 34 engages the contact 36. This prevents the development of an instantaneous high voltage because of the inductance of the relay coil, which would result if the energizing circuit were opened, thereby causing pitting and burning of the relay contacts.

The de-energization of the winding 32 of the relay 31 causes the contacts 30 and 39 to open, the opening of the contact 30 de-energizing the primary winding 22 of the transformer 21, whereupon the igniting spark from the points 19 to the burners 14 is discontinued. The opening of the contact 39 has no effect since the winding 32 of the relay is already deenergized.

As long as the temperature within the furnace is between 1300° F. and 1500° F., the combustible mixture delivered thereto from the burners 14 and the blower 18 is promptly ignited.

If the temperature within the furnace falls below 1300° F. for any reason, the contact 34 of the regulator 35 re-engages the contact 37, after disengaging the contact 36, thus re-energizing the winding 32 of the relay 31 which closes its front contacts and holds it in operated position, as already described. This restores the igniting sparks adjacent the burners to insure ignition of the combustible mixture issuing therefrom.

Should the voltage of the source 27 decrease materially, the shutoff valve 23 is closed by a restoring spring or counterweight (not shown). Suitable adjustment for the solenoid and the valve operating mechanism may be provided to insure shutoff at any predetermined decrease in the voltage of the source 27. Similarly the relay 32 may be designed or adjusted to drop out at such voltage, terminating the igniting sparks. The motor 29 continues to operate on reduced voltage, although its speed is correspondingly reduced. A forced draft through the tubes 13 is thus maintained to remove any unburned combustible. This removes the hazard of explosion on restoration of the line voltage and the igniting sparks.

Should the fuel pressure fall below a predetermined valve, the mercury switch 42 is closed by the pressurestat 40, thus shunting the winding 32 of relay 31. This deenergizes the igniter. At the same time, as already explained, switch 42*a* causes the valve 23 to close. Restoration of the pressure will open the switches 42 and 42*a*, re-energizing the igniter and opening the valve 23. A protective resistor 24*a* in series with the solenoid 24 serves the same purpose as the resistor 33.

It will be apparent from the foregoing description that the invention provides a simple yet highly effective control system for furnace burners or other devices consuming fluid fuel. Igniting sparks are struck as soon as fuel and air are delivered to the burner. The sparks are discontinued after the radiant tubes are heated to normal operating temperature, at which any combustible is immediately ignited by contact with the tubes. This reduces the energy loss involved in maintaining the ignition sparks continuously. At the same time, failure of the line voltage causes the fuel to be shut off and the igniting sparks to be extinguished. The igniting sparks, furthermore, are automatically restored, should the furnace temperature fall below that at which a combustible mixture delivered to the tubes 13 ignites readily.

Although I have illustrated and described herein but a preferred form of apparatus for practicing my invention, it will be understood that changes in the exact embodiment described and illustrated herein may be made without departing from the spirit of the invention or the scope of the appended claim.

I claim:

In a furnace, a radiant tube, a burner supplying fuel thereto, a spark-gap igniter for said burner, said tube in normal operation being heated by combustion gases traversing it to a temperature at which, after a temporary interruption of the fuel supply and extinguishment of the burner flame, the fuel from the burner is re-ignited on restoration of the supply, by contact with the wall of said tube without the aid of said igniter, and means responsive to the temperature of said tube effective to maintain said igniter continuously energized until the tube is heated to said re-ignition temperature.

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